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PUBLIC HEALTH REPORTS.

UNITED STATES.

Report on the epidemic of plague in Kobe and Osaka from November, 1899, to January, 1900.

[By Dr. S. Kitasato, director of the Imperial Institute for Infectious Diseases, Dr. T. Takaki, Dr. K. Shiga, and Dr. G. Moriya.—Translated and abstracted by P. A. Surg. M. J. Rosenau, U. S. M. H. S.]

THE INFLUENCE OF THE HOUSE RAT IN SPREADING THE DISEASE.

The municipal authorities at Kobe and Osaka paid 5 sen (about 2½ cents) for rats, whether dead or alive. Many cities in which plague did not exist followed the same example. The inhabitants of Osaka, especially the rich tradesmen, have a peculiar superstition that the house rat is the guardian angel of the Empire.

From the middle of November, 1899, to the end of January, 1900, 20,000 rats were paid for in Kobe and 15,000 in Osaka. In fact, more rats were caught and many destroyed without the facts coming to the knowledge of the authorities.

More dead rats were found in Kobe than in Osaka. Of those found in Kobe, about one-fifth were infected with bacillus pestis. In Osaka, only one-tenth were infected.

Bacilli very similar to the bacillus pestis were often found in the dead rats. This organism could readily be mistaken for the true cause of plague; the authors, therefore, used cultural and experimental methods, in addition to the microscope, in order to make a diagnosis.

As may be seen on the plans of the cities of Kobe and Osaka, the territory in which pest rats were found is much more extensive than the cases.

The relation of the individual cases to the rats is not fully evident; however, it can be said with certainty that the rats take the disease first and afterwards man. This is probably due to the fact that rats have more opportunity to come in contact with infected material than man.

Two hundred and ninety-one dead rats were found in Kobe from November 19, 1899, to January 26, 1901, of which 61 contained bacillus pestis.

During the epidemic in Osaka 200 dead rats were found, of which 23 were infected with the bacillus pestis.

There is no doubt that many more dead rats were found and disposed of. Fear of the disinfection that followed the finding of a dead rat induced the people to hide them from the authorities.

CLINICAL STUDIES.

Of the 64 cases, 43 were male and 21 female. The majority of cases occurred between 10 and 40 years of age. There were cases in children under 10 and in adults over 60 years old.

The majority of cases occurred in working classes; then in sailors and people connected with shipping from infected harbors.

During the outbreak of plague-pneumonia in Osaka 3 physicians and their attendants were infected.

PERIOD OF INCUBATION.

The stage of incubation is generally stated to average about three days, and at most ten days. The authors had occasion to study more closely the time of incubation of the pneumonic and bubonic forms of the disease. In 12 cases cited the time of incubation was:

Diseases.	Cases.	Incubation.	Diseases.	Cases.	Incubation.
Pneumonic plague.....	1	Days. 2 to 4	Pneumonic plague.....	7	Days. 3 to 4
Do.....	2	2 to 4	Do.....	8	4 to 5
Do.....	3	4 to 9	Do.....	9	5 to 6
Do.....	4	1 to 4	Bubonic plague.....	10	6
Do.....	5	4	Do.....	11	7
Do.....	6	1 to 4	Do.....	12	7

The above-mentioned cases of pneumonic plague were infected by direct contact—that is, through coughing or the sprinkling of infected secretions, etc.

The sick were isolated in special hospitals. The suspects were kept under observation in special places for ten days.

PRODRONES AND FIRST SYMPTOMS.

Usually the disease was ushered in suddenly. Some, however, complained of feeling ill, headache, lumbago, loss of appetite, etc., one to six days before the disease appeared. When the disease appeared suddenly the first symptoms were chilly sensations or chills, seldom headache, lumbago, muscle pains, nausea, vomiting, and still more rarely joint pains.

In 19 cases general symptoms appeared before the buboes, while in certain cases the buboes appeared with the chills and fever.

SKIN AND MUCOUS MEMBRANES.

Skin hemorrhage was noticed in 4 cases, 3 of which were only noticed at the post-mortem, the other one at the sick bed. Petechiæ occurred mostly on the extremities, although in one case they covered the whole

body except the face. They were irregularly distributed and commonly the size of a pin head.

In such hemorrhages, large and small, the bacillus pestis occurred in large numbers. Subscleral and subconjunctival hemorrhages were noted in 2 cases at necropsy.

In 3 cases roseolas were observed that disappeared under pressure of the finger. As there were no mosquitos in Kobe and Osaka during the winter, these eruptions could not have been due to the bites of these insects, as H. F. Miller believed was the case in a Hindoo patient in India.

CARBUNCLES.

Plague carbuncles were noted in 5 cases, especially about the buttocks.

The German plague commission considers the carbuncle in plague to be mostly secondary—very rarely primary. The Austrian commission also considers the occurrence of primary carbuncles as very doubtful. The authors, however, found in 3 of their cases that the carbuncles preceded the appearance of the buboes by two, four, and thirteen days. The bacillus pestis was found sparingly in superficial layers of the carbuncles. In the necrotic layers a variety of saprophytes, but in the deep infiltrated places they always found with certainty considerable numbers of the plague bacilli.

The prognosis of the plague carbuncle itself is generally fair. Two cases treated in hospital recovered, the other three cases died in their houses without treatment.

PLAGUE BUBOES.

The femoral and inguinal glands are, as a rule, most frequently affected, more rarely the cervical, and still more rarely the axillary glands. A peculiarity of this epidemic was the relative frequency of buboes of the cervical and submaxillary glands. These cases appeared usually as secondary to tonsillitis which was probably the point of entrance for the plague germs.

TABLE OF LOCALIZATION OF THE BUBOES.

Femoral, 9; inguinal, 11; femoral and inguinal, 6; femoral, inguinal, and iliac, 4; inguinal and axillary, or crural, 7; 78.7 per cent.

Axillary, 4; 8.5 per cent.

Cervical (or submaxillary), 4; pest tonsillitis in the submaxillary buboes, 2; 12.8 per cent.

The changes in the glands consisted of simple hyperæmia, inflammation, hemorrhagic infarction, and softening. The pest bacillus in the inflamed hemorrhagic glands was usually altered in form, rounded, vacuolated, and long forms, and irregular staining. The secondary buboes were observed in plague carbuncle and plague tonsillitis, but never in plague pneumonia.

DIGESTIVE SYSTEM.

Three cases of primary changes in the tonsils were observed. This affection was never secondary. All 3 cases finally succumbed to plague septicæmia and showed early cerebral symptoms. One case was confused with acute meningitis.

In the diagnosis of doubtful cases of plague it is important to examine the throat, for tonsillitis is not rarely an early symptom and may be diagnosed with certainty by the bacteriological examination.

The tongue is dry, white, yellowish-white, or dirty brown. Rarely does it remain normal and moist with good appetite.

Nausea and vomiting appear in varying degree from the initial symptom to the last stage of the disease. Blood in the vomit is seldom seen.

There may be constipation or diarrhea. The authors never saw severe diarrhea in their cases. Mucus in the stools was frequently noticed.

The question whether primary infection through the intestines occurred in any of the cases was not determined with certainty.

RESPIRATORY SYSTEM.

Cough, sputum, feeble or rough râles occurred as symptoms of the bubonic or skin form of the disease. They are the symptoms of angina, bronchitis, or pneumonia, as in other acute infectious diseases. In addition to these secondary affections there is a true primary plague pneumonia. In Osaka the authors noted 13 cases of such pneumonia that were transmitted one to another by contact. All these 13 cases terminated fatally.

CIRCULATORY SYSTEM.

In the plague pneumonias there was no diminution in the area of cardiac dullness. The heart sounds and pulse were normal at first, but afterwards the sounds became weak and the pulse weak, thready, irregular. The pulse is quickened to from 100 to 160 per minute.

In addition to the bacillus pestis, an organism resembling chicken cholera and diplococci and staphylococci were found in the blood. The plague bacillus usually appeared in the blood in the later stages of the disease.

NERVOUS SYSTEM.

The principal symptom on the part of the nervous system is the disturbance of consciousness. The mind may remain clear to the end of the sickness, in which case the patient desires a speedy death on account of the pain. Usually the patient complains of headache or dizziness, and gradually somnolence, delirium, and coma develop.

URINE.

The urine was diminished in quantity to 1,000 and often to 500 c. c. It was usually acid and seldom alkaline, and contained at times traces of albumin. One patient had bloody urine before death.

MIXED INFECTION.

A cocco-bacillus resembling that of chicken cholera and a bacillus staining deeply by Gram's, more rarely staphylococci and streptococci, were found associated in the disease.

In Kobe 2 such cases of mixed infection were observed. In the first case the septicæmic bacilli were richer in the glands than the plague bacilli, and in the blood they were almost in pure culture. The other case was a mixed infection with the septicæmic bacillus and staphylococci. In the glands only a few plague bacilli were found, whereas the associating organisms were in abundance.

In Osaka 4 cases of mixed infection were studied. In these cases the septicæmic bacillus and the bacillus resembling chicken cholera were very abundant, almost in pure culture in the blood, while the bacillus pestis was but sparsely present.

It was noted that in the mixed infection the septicæmic bacillus and the bacillus resembling chicken cholera multiply more abundantly in the glands than the bacillus pestis. When these organisms enter the circulation they play the principal rôle, the patient becomes very ill and soon dies.

NECROPSY FINDINGS.

Rigor mortis comes on early, even while the body is still warm, and generally is strongly marked. A relatively weak rigor mortis is peculiar to the mixed infections.

DIAGNOSIS.

The diagnosis can only be made with certainty by bacteriological study. The clinical symptoms and sudden appearance of fever, buboes and great prostration appearing very soon, lead to but uncertain conclusions.

The buboes, carbuncles, inflamed tonsils, sputum, and blood are especially recommended for the bacteriological examination. It is important to avoid incisions and extirpations in patients. They do much more injury than the puncture with the needle of a syringe. Sufficient material can be had out of the inflamed tissue by means of the syringe and needle.

A negative result from the bacteriological work does not exclude plague, for the organism in the beginning of the disease may be so few in number that they may be missed on microscopical examination. Especially in the beginning of plague pneumonia the sputum must be examined very carefully many times.

COURSE AND PROGNOSIS.

The authors mention 2 cases of brothers, 7 and 11 years old, who came home in the evening from play and were dead in twenty and thirty hours, respectively, of plague. Generally the disease lasts five to eleven days.

Of the 64 cases, 58 died and only 6, or 9.4 per cent, recovered. The pneumonic and septicæmic types were invariable fatal.

Four cases of bubonic plague and 2 of carbuncular plague recovered.

THERAPY.

In 13 cases the buboes were extirpated. Of these 4 recovered. The operation relieved the pain and the patients felt better in the favorable cases. In the other cases the fever and local pain remained as before the operation. Early extirpation gives better results than when the operation is done in the later stages of the disease, when septicæmia is present. The authors point out that it is necessary to use very strict antiseptic precautions in treating the wound in order to destroy the remaining plague bacilli.

SERUM THERAPY.

Yersin serum was used in Osaka toward the end of the epidemic in 7 cases of the pneumonic form and 5 cases of the bubonic form of the disease. Only 1 case of the 12 recovered. That was a case of bubonic plague in which the neck, axillary, and inguinal glands were affected. He was given 270 c. c. of the serum between the fourth and fifteenth day of the disease.

One case died after getting 130 c. c. of the serum from the ninth day of illness. In no case was less than 30 c. c. used. In most of the cases the disease was well advanced before the serum was injected and death often occurred before sufficiently large doses of the serum could be administered. No ill effects from the use of the serum were noted.

HAFFKINE PROPHYLACTIC.

The physicians and nurses in the Momoyama hospital in Osaka, and others, were given injections of the Haffkine prophylactic. They all remained free of the disease excepting one woman, a nurse (in whose family there was a case of plague), who died of the pneumonic form of the disease. With her mother, she nursed her husband, who had the pneumonic form of the disease, from the night of January 5 until 10 o'clock the next morning. Both women were isolated in a special room, and the nurse was given 2 injections of Haffkine prophylactic, one on the 6th and one on January 8. Despite this fact she took sick on January 10 of plague pneumonia, and her mother took the same form of the disease the next day. The nurse was undoubtedly infected before she received the injection. This case teaches that active immunization during the stage of incubation of the disease is unavailing and even dangerous.

YERSIN SERUM AS A PROPHYLACTIC.

Yersin serum as a prophylactic was used in two women who received 20 c. c. Both women had been in attendance upon cases of the pneumonic form of the disease. Unfortunately, both women took this form

of the disease two and a half days after the injection, therefore, they received the injection of serum during the stage of incubation of the disease. No case of the pneumonic form of the disease was cured by the serum, although in one case 300 c. c. were used.

SHIGA'S PROPHYLACTIC.

One of the authors, Dr. K. Shiga, during the time of the dysentery epidemic, tried prophylactic injections against this disease. In accordance with this method the vaccine is made by rubbing up a culture of the bacillus of dysentery in an agate mortar in physiological salt solution and then heating it to 60° C. for twenty minutes. The bodies of the bacilli dysentericæ are absorbed with great difficulty and cause a high grade infiltration at the point of injection. In order to prevent this an equal portion of the serum is added to the vaccine. In this way there is produced very slight reaction, and the bacilli are easily absorbed, and the injection causes very little disturbance. After this injection of the combined serum and vaccine there follows an interval of several days, when the second injection is given. This consists of the vaccine alone, without the serum. In this case the bacterial substance is readily absorbed.

This method was also tried in the case of plague. The vaccine was made in the following way:

Agar cultures of plague were grown at 30° C. in the incubator for three days. The colonies are taken off with a platinum loop (cæse), and rubbed up with the physiological salt solution, so that 1 c. c. of the vaccine contained 1 cæse of the bacilli. This suspension was then heated to 60° C. for thirty minutes and 0.5 per cent carbolic acid added, and left standing twenty-four hours.

The dose of this vaccine is as follows: First injection, vaccine, immune serum, of each 0.6–1.0 c. c.

After several days when the reaction has disappeared the second injection is given: Vaccine, 0.6–1.0 c. c.

This method was used in 47 healthy persons. None of them took sick of plague. The reaction following the injection was very mild. The symptoms of reaction were:

1. Light pain on pressure or feeling of tension over the point of inoculation, otherwise no symptoms.
2. Local sensitiveness and redness with elevation of temperature, 37.5° C.
3. More rarely some swelling of the seat of injection, fever (38° C.), light headache with chilly sensations.

During epidemics of plague it is recommended, according to the danger, to give still larger doses of the vaccine or to give 3 injections in increasing doses.